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Dissolving Views in the Sky

The moon, too, with its series of **dissolving views**, full and red, had risen to us on the mountain on the previous night, and now it was the ring of Saturn as it appeared girt by a single delicate cloud; then the ridges of cloudland painted snowy mountains on its surface; or it all became veiled from sight save a lurid spot in the vast vapor.

"An Ascent of Mount Saddleback,"
The Literary World, August 30, 1851

This issue of the *Gazette* has taken an unusually long time to prepare, so I have limited it to 20 pages in order to get it out. John Davidson has contributed a rather technical article on limelight illumination, comparing historic published information on the brightness of limelight lanterns with modern measurements that he has made himself. Those not mathematically inclined may wish to skip over the equations in his article, but I think most readers will be able to understand the results of his interesting research. He found that images projected on a screen by a limelight lantern were considerably less bright than are images on a modern movie screen, but of course, 19th century audiences were used to dimly-lit rooms. I am grateful to John for sending this article, which was a bit of challenge to format because of its equations, figures, and tables.

Another feature of this issue which took a good deal of time is a special edition of The Research Page, which focuses on contributions by scholars in Latin America and Spain to magic lantern research. This section required me to read a number of scholarly articles and books in Spanish and then summarize them in English, not an easy task. Portuguese was too much for me, and I am thrilled that Rafael de Luna has provided a summary of an important paper by a Brazilian scholar.

The issue winds up with an essay review by Terry Borton on two books and a DVD related to a musical lantern slide show of American Indian photographs by Edward S. Curtis. There also is another book review on visual spectacles and the science of geology in the 19th century.

I already have some material in hand for future issues, including another substantial article by John Davidson, but I can always use more. I hope to begin work on the Spring 2011 issue as soon as classes at my university are finished. My hope is to get back on schedule so the *Gazette* issues actually correspond to the correct seasons of the year.

I want to remind members of a couple of announcements that have gone out on the society's email newsletter. First, I am accumulating material for a special Gazette issue featuring American iconography of the magic lantern, modeled on the series of *Lantern Image* books published by the Magic Lantern Society in Britain. Terry Borton already has supplied me with a generous assortment of images of lantern shows, lantern ads, etc., as have a few other people, but I can still use any sort of visual images of magic lantern shows on trade cards, in books, magazines, etc. Please send JPEG images (350 dpi) to me by email.

Finally, please check out the Magic Lantern Research Group at https://www.zotero.org/groups/magic_lantern_research_group. This site is accessible to the public and best viewed using Mozilla Firefox as the web browser. In the Group Library, you will find links to all back issues of *The Magic Lantern Gazette* and *Magic Lantern Bulletin* online through the San Diego State University Library. You also will have access to hundreds of web pages related to magic lanterns, hundreds of copyright-free digital books going back to the 17th century, a comprehensive bibliography of scholarly articles on the magic lantern, mostly from the 1970s to the present, and much other useful research material. You also can contact me for information on how to join the Magic Lantern Research Group .

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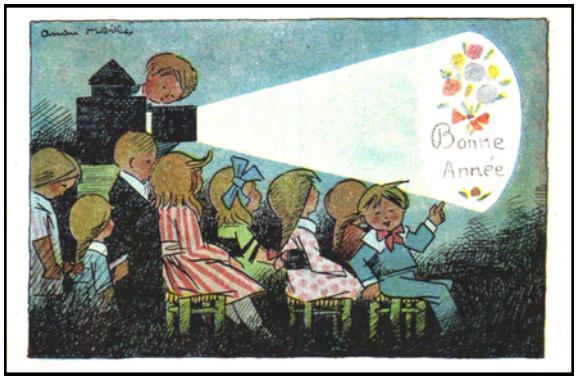

A belated Happy New Year to all.

How Bright Were Magic Lantern Slides on a Screen? A Photometric Study of Limelight and Notes on its Use in the Magic Lantern

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Abstract

Measurements of the light output of an historic mixed jet limelight with a 1.4 mm torch tip run on a propane/oxygen mixture indicated that the burner operated optimally at an output of 3000-4000 lumens with the light output highly dependent upon fuel gas flow and burner adjustment. An output above 4000 lumens could not be obtained because the high gas flow required caused the torch to blow out. Below 3000 lumens light output dropped off dramatically as the gas flow was reduced. A simple correlation was found which enabled historic "candle power" measurements to be converted to lumens and satisfactory agreement was found between historic and modern data. Measurements of lantern screen illumination with a limelight of known output were performed and supported conclusion that historic magic lantern shows of the lime light era were exhibited at much lower levels of screen illumination than are thought acceptable today.

Introduction

In an earlier communication to the *Gazette*,[1] I listed a number of historic light sources for the magic lantern, along with historic photometric data in terms of "candle power." Unfortunately these data are not compatible with modern photometric practice, which rates light output in terms of luminous power, or flux measured in lumens. The purpose of this article is to outline an experimental procedure and results obtained on the light output of an historic "mixed jet" lime light run on a propane/ oxygen mixture and to apply these results to the magic lantern. This study, to my knowledge, is the only attempt to apply modern photometric measurements techniques to this historic light source. The results provide a simple correlation that enables one to convert historic candle power measurements to their modern lumen equivalents with respect to the limelight.

When you go to buy any type of light bulb, you look for a bulb of the same wattage as the one you intended to replace. The wattage rating of a bulb refers to the electrical power the bulb consumes. Unfortunately this is only part of what you should consider; you also should be concerned about the ***power of the visible light*** produced by the lamp in question. This is always stated in ***lumens*** on the side of the box and typically runs from about 11 to 16 lumens per watt. Relatively recently so called "long life" or 130 volt bulbs have gone on the market. A 67-watt bulb that I examined was rated at only 7.9 lumens per watt, meaning for the consumer, more electricity used for less light. Running an incandescent bulb lamp at a lower voltage than that of its say 750-1500 hour voltage rating will definitely lengthen its useful life, some 2.5 times for a 130 volt lamp run at 120volts. However you are getting less light for your energy dollar illustrating once again that there is never a truly free lunch!

The science of photometry got started by the comparison of a light source with a standard, originally a "standard candle," and utilizing the fact that light falls off from a point source as the square of the distance. Usually a light source can be considered a point source at a distance of about 20 times its size. A point source is also one which emits light equally in all directions, a condition which is rarely met with in practice. The most serious problem, however, has been the stability and reproducibility of the standard itself. So-called "standard candles" were found to vary as much as $\pm$ 20%.[2] Various forms of lamps were used in the past, the first being the Carcel lamp, which burned colza oil and was introduced in 1800. However the lamp was difficult to manage, and its output varied from 9.4 to 10 candles, about 6% under standard conditions. The pentane lamp, which burned the fluid for which it was named, was introduced in 1877 and underwent a number of modifications. In its final form it gave an output of 10 candles and was adopted as the official standard of the British Gas Referees in 1898. It was commonly suspected by the illuminating gas customer that he was being cheated by the gas supplier and that the gas being sold was diluted with air. Hence the need for accurate photometric standards. Just as weights and measures were certified by the government, so gas had to be certified as to light output. The Hefner lamp of

1884 used amyl acetate as a fuel and was the standard light source of Germany up until 1940! Attempts to devise standard lamps burning anything but a chemically well-defined fuel of definite composition were all failures.

The modern standard first proposed by Violle in the 19th century is based on the light emitted by 1 square centimeter of platinum held at its melting point.[2] It was finally adopted by the International Committee of Weights and Measures in 1948 and the term "standard candle" was replaced by the term ***Candela*** . The candela is the source intensity of a 1/60 square cm of the opening of a glowing cavity (black body) held at the temperature of solidifying platinum. Such a source is used to calibrate incandescent lamps, which are used as secondary standards.

Historically to make a comparison, the standard lamp or candle, along with the unknown, were set up on an optical bench and a comparison device adjusted between the two sources of light until the intensities were judged to be equal. The ratio of the standard to the unknown lamp intensities is then proportional to the square of the distances to the equal intensity point. A variety of comparison devices have been employed, and these, along with standard light sources and their problems are discussed by Walsh.[3] Another problem is that of color temperature. If the lamps do not posses the same "whiteness" or spectral distribution in modern terms, they cannot be accurately compared using a simple photometer employing flame standards. This could have been a real problem with the limelight, with a color temperature of about 3000 Kelvin (K), versus a flame standard of about 2000K.

The basic definitions required in measuring light output are:

(1) The **Candela,** or the unit of luminous intensity formerly called the standard candle has been described previously. It is the starting point in photometric measurements.

(2) The **Foot Candle** (fc), or unit of illumination. If a light source of one candela **evenly** illuminates an area of one square foot at a distance of one foot, the illumination is said to be one foot candle. Illumination is generally the quantity which is measured using a foot candle meter and to photographers is known as an incident light meter. If metric units are used, measurements are stated in lux, with 0.0929 fc/lux being the conversion factor. Clearly the above definition can hold only if our source is uniformly radiating in all directions, and our square foot area is on the surface of a sphere. This leads to some interesting conclusions. Since the area of a sphere is $4 \pi r^2$ with r=1, the total area is 4 times 3.1416 or 12.5664 square feet. Thus all the light coming from our point source of one candela is illuminating the interior of an imaginary sphere of 1 foot radius, with an illumination of one foot candle.

(3) This above leads to a definition of luminous power output or **luminous flux,** known as the **lumen (lm).** The lumen is the luminous flux emitted by a source of one candela falling on one square foot of the surface of a sphere of 1 foot radius. Thus, the total light output of our one candela source is the area of our sphere of one foot radius, or 4π since r=1. This leads to a more commonly used definition based on the on a quantity known as the solid angle or steradian. Consider a sphere of radius R and an area on the surface of the sphere A. Together they form a cone with the apex at the center of the sphere and a base on the surface of the sphere.. The solid angle described by the cone is equal to A/ R^2. If the area is circular, then the angle is similar to those of plane geometry. Clearly a cone with a small circular base (small solid angle) is easily visualized and differentiated from a cone with a large base (large solid angle), provided the heights of the cones are the same height (the two R values are equal). This leads to a definition of the lumen as the light flux emitted by a source of one candela over an angle of unit solid angle or one steradian.

Since luminous flux is a measure of power (i.e., energy per unit time), and energy can be neither created nor destroyed, with a fixed number of lumens, the measured illumination such as might be made with a foot candle meter of the light coming from a magic lantern and falling on the screen is directly proportional to the area illuminated. Thus, if we measure the intensity of light on a lantern screen with an illuminated area of 10 feet by 10 feet, or 100 square feet, and find that it is 5fc, doubling the area illuminated to 14.14 feet by 14.14 feet, or 200 square feet, will reduce the illumination to 5/2 or 2.5fc. Similarly, if we know the area of our projected image in square feet and multiply this by the measured illumination in foot candles, we can determine the number of lumens coming out of our lantern, providing the screen illumination is even. If your meter reads in lux, multiply the reading by 0.0929 fc/lux. Remember that in our definitions, we were concerned with areas on spherical surfaces, but at practical distances such as the distance of a lantern from a screen, the sphere radius is so large that the area of a plane surface may be substituted. Basically, all projected images are strictly in focus on a spherical surface of a radius equal to the distance from the projection lens to the screen; hence the curved screens required on super-wide screen formats such as Imax ™ .

If our light source is small enough to be considered a point source, and it radiates equally in all directions or can be assumed to do so, measurement of the total luminous flux or lumen rating of the lamp is easy. All one need to do is to:

(1) Measure the light illumination with a foot candle or lux meter at a distance from the lamp large enough that the inverse square law applies

(2) Multiply the square of the meter to lamp distance by the foot candle reading. If your measurement is in lux, convert it to fc by multiplying by the conversion factor 0.0929fc/lux.

(3) Multiply the result in (2) by 4 π or 12.566

Keep in mind that if a light source must radiate equally in all directions for this simple approach to work, This is generally not the case and is certainly not true in the case of the lime-light.

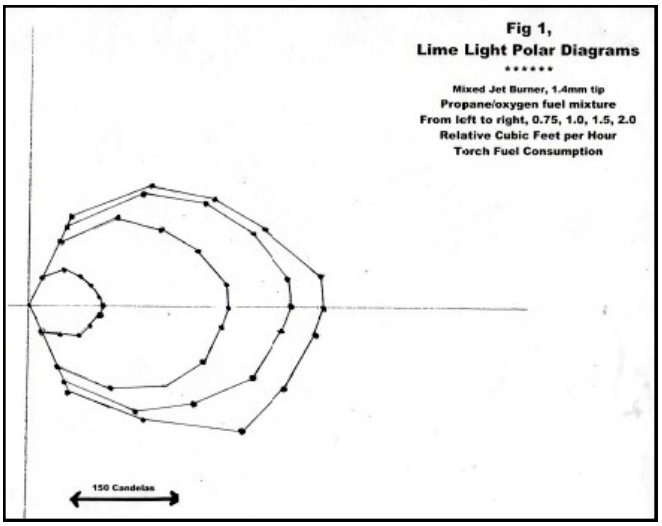
However with some limitations, in the case of the small FEV quartz halogen 200 watt bulb, good results were obtained. This bulb has an inverted "V" filament, with each leg being only 3/8 inches long. Positioning the bulb 28.125 inches from the lux meter with the "V" filament parallel to it, as it should be positioned with respect to the condenser if used in a magic lantern, a value of 893 lux was obtained. Converting this to fc and multiplying this by the square of the lamp-to-lux meter distance in *feet,* a value of 455.71 was obtained. This value multiplied by 4π, or 12.5664, gave a value of 5727 lumens. This is within 2.2% of the more exact method of measurement based on integration of the intensity values from the polar diagram, a method which will be described shortly with re-spect to limelight.

It is important to note that for the two techniques to agree, the filament must be orientated in the same position with respect to the foot candle meter. Also, it should be observed that the values obtained were slightly higher than the stated output of 5500 lumens. This is because measurements taken at right angles to the "V" filament are lower. By averaging the two values, the agreement is within 1%, when the Russell angle method is used (see below).

Since even the FEV bulb is not a point source, we should de-rive our luminous output by a more exact technique. Al-though there are several ways of approaching this problem, the measurement of illumination intensity as a function of angle from the source is the most suitable for use with lime-light. The measurements must be made in the vertical plane, i.e., along a plane which passes through the long axis of the lime cylinder and the point where the flame impinges on the cylinder. Such measurements, when plotted with the angles being measured from the point of flame impingement, yield ***a polar diagram*** (Fig. 1).

Experimental Work

I used an antique mixed jet limelight with a jet diameter of 1.4 mm. This jet diameter was very close to the average of 5 jet diameters measured in the author's collection, which yielded a value of 1.42mm, with a standard deviation (SD) of 0.2mm. Similarly a check of 13 mixed jet burners at Jack Judson's Magic Lantern Castle some years ago yielded an average of 1.43mm, SD = 0.32mm . Measurements of jet diameter were made with a capillary tube gauge reading to 0.01mm. Thus it was felt that the burner chosen for light output study was a good representative of its class.



Jet diameter is a critical parameter in the performance of any oxy-gas torch. The torch flame is stable only if the rate of gas flow through the jet is equal to the rate of flame propaga-tion back into the torch. With too rapid a gas flow, the flame starts to burn away from the torch tip and eventually blows out. Too slow a gas flow causes the flame to "flash back" into the torch, with potentially explosive combustion either inside the torch or the supply tubes. During much of the 19th century, gas supplies were stored in large rubber bags, and if somehow the oxygen and gas supplies inadvertently became mixed, a flash back could be disastrous. Today oxy-gas torches, such as the common oxy-acetylene welding torch, usually are outfitted with explosion-check valves. These are small metal tubes that contain a check ball, which is kept from its seat by the normal gas flow through the torch. If a flash back should occur, the explosion forces the ball into its seat, thereby cutting off the flow of gas and extinguishing the flame. Alternatively, the gas may merely burn inside the torch with potentially disastrous results to the torch if this situation is allowed to continue! If such a flash back occurs, gas and oxygen torch valves should be immediately closed. Historic limelight burners often used cylinders packed with screen just before the torch tip to prevent flash back from traveling back any further. The principle evoked was that of the Davy coal miner's safety lamp, where a lamp flame is isolated from a potentially explosive coal mine atmosphere by a wire gauze. The gauze cools the flame sufficiently that it will not propagate through the gauze and thus ignite explo-sive mine gases. How effective these devices were in protect-ing the lime light gas supplies is open to question, and indeed Wright claimed they all were ineffective, and the only real safeguards were the use of pure gasses, equal pressure on the bags, and a clear torch tip so that the gasses always flowed outward.[10] Wright mentioned the check valves similar to the ball checks described earlier, but he did not trust them.

In the apparatus used in this study, gases from the appropri-ate pressure-regulated cylinders were conducted to flow

gauges protected by ball explosion checks, and flexible rubber tubing led from the flow gauges to the limelight burner. It was found that it was best to regulate the gas flow with the flow gauge controls and leave all other valves in the low-pressure gas handling system in the wide open position.

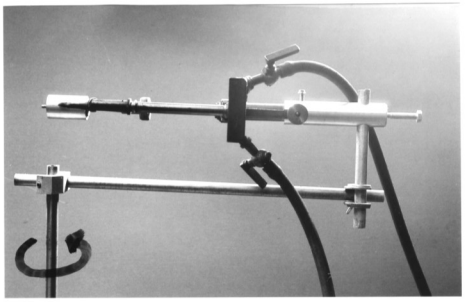
Limes—Italian Carrara marble drill core cylinders ¾ inches in diameter and approximately 2 inches long were obtained from *Fairplay Stone Carvers LLC* (4) The ends of these were squared in a metal turning lathe using water as a tool lubricant and cooler. A 1/8" diameter masonry drill was used to drill a hole through the entire length of the marble cylinder for the support rod in the lime light burner. It was found best to start and center the hole in the lathe, but to drill all but the first 1/8 inch or so using a drill press. This is because the drill heats up quite rapidly and must be cooled using copious amounts of water. The water and the drill chips form a paste which must be frequently washed from the drill so the hole is drilled is steps of about ¼ inch before it must be pulled back from the work, cleaned, and cooled. It also is important to cement the bottom of the lime to a piece of wood or aluminum. This is because when the drill "breaks through" the end of the cylinder, it is apt to shatter and ruin a good portion of it unless cemented firmly to a base. Five-minute epoxy was used in this study, and the lime freed from its support after drilling by careful heating with a propane torch to 100°C or so. The cylinders were calcined in a small electric tube furnace and held a 1000°C for about two hours after a heat-up time of ½ hour. The electric current to the furnace was then shut off and the furnace and contents allowed to cool to a temperature of 200-300°C. The limes were then removed with suitable tongs and stored in glass jars lined with high-temperature insulation. Small canning jars were the only ones found satisfactory, since they have tight fitting gasket sealed lids.

Photometric Measurements--A 6 inch machinist's rotary table or indexing head equipped with a 4 inch 4 jaw chuck and capable of reading and setting angles to 20 seconds of an arc (0.005 degree) was securely clamped to a sturdy table with the chuck orientated in the vertical position. Since the measurements of light intensity versus angle must be made along an axis of symmetry in what is normally the vertical plane, the limelight had to be positioned on its side with the lime parallel to the surface of the work table. A suitable bracket of about ½ " diameter rods and "flexiframe" laboratory clamps was assembled to do this, and the point of focus of the flame on the lime centered over the center of rotation of the index head as shown in Plate 1. A centering jig and an aluminum cylinder of the proper diameter and length served as a "stand in" for the lime during the centering adjustments.

Measurements of illumination intensity were made by means of a "lux meter" (Cen-Tech ™ item #41728, Harbor Freight Tools Inc.). The meter was protected from stray light by means of a 3" internal diameter X 12" long length of PVC pipe with the interior lined with black matte paper. The lux meter and its protective tube, mounted on a massive laboratory stand, were positioned 3.52 feet from the center of rotation of the index head, and a laser level used to assist in alignment of the apparatus

Plate 1

The lime light clamped in a horizontal Position in the photometric apparatus Note axis of rotation

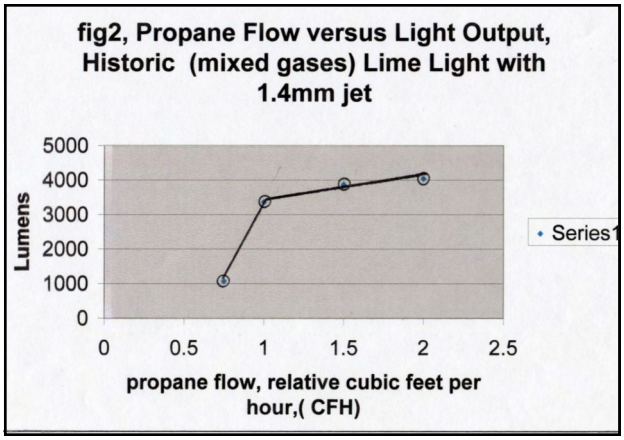


The basic theory of the measurements is outlined in Appendix I, and although it might seem complex, in practice it can be quite straightforward. Imagine a plane passing at right angles to the long axis of the lime and also passing through the point of impingement of the flame on the lime. This plane defines the 90 degree point of our measurement scale. Measurements of illumination intensity are made at a series of angles above and below 90 degrees in a plane which also passes through the point of flame impingement and is at 90 degrees to the plane defining the 90 degree point. If measurements are made at a set of angles, known as Russell angles, averaging these values leads directly to the output of the light source under study in lumens. A series of 10 Russell angles was judged sufficient and they are listed along with their mode of computation in Appendix I .

In order to test the apparatus, measurements were made on a number of incandescent lamps rated from 5500 to 532 lumens. In all cases agreement was within 5.5% or better with the values stated by the manufacturer. In the case of the 200W FEV bulb discussed earlier, agreement was within 1% when values taken parallel and perpendicular to the inverted "V" filament were averaged. These differed from the mean experimental value of 5449 lumens by +6.5 and -8.4% respectively. Care was taken in all cases to run the bulbs at their rated wattages, a watt meter and a variable auto transformer (Variac) being used. In the case of the "long life" 130 volt bulbs the line, voltage was carefully controlled to 120 $\pm$ 0.2 volts.

Fig. 1 presents plots of illumination versus Russell angle for the lime light used in this study. Such plots are known as polar diagrams, and in Fig. 1, various polar diagrams are

shown for different operating conditions of the torch, such as fuel and oxygen flow. The general procedure adopted was to make the first measurement at the Russell angle of 84.3 degrees and optimize its performance at this point with respect to oxygen flow and torch tip to lime spacing. Illumination levels were then taken at the other nine Russell angles and the results averaged. This average was then treated exactly as the data from the FEV bulb discussed earlier, ***except*** that the product of the distance squared and the measured foot candle value was multiplied by 2π instead of 4π. The reason for this is that the limelight only emits light over a hemisphere. Note that the polar diagrams in Fig. 1 are generally quite symmetrical around the 90 degree axis; however, problems with respect to the behavior of the lime did occasionally create anomalous results. It was not practical to adjust the lime during the course of a given experimental run, and cratering was a general observation. The most symmetrical polar diagrams were produced under conditions of low gas flow and relatively low light output.



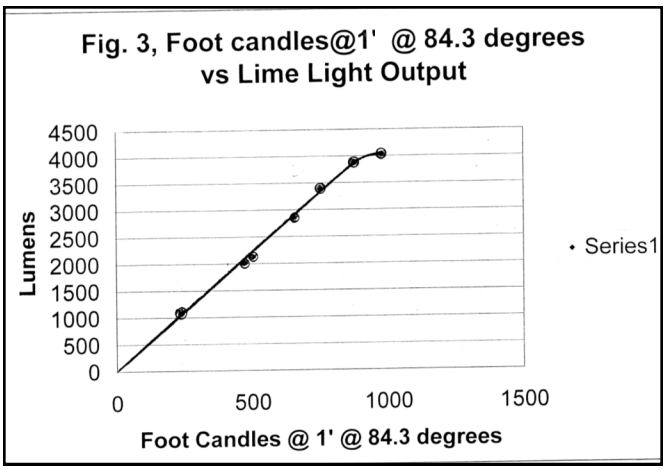
In Fig. 2, a plot of relative propane flow versus light output is presented. The torch seemed to operate best between 1 and 2 relative cubic feet per hour of propane flow (RCFH). Below 1 RCFH, the light output dropped dramatically, while above 4 RCFH, the torch blew out. Thus, about 4000 lumens would appear to be the maximum achievable with the torch using propane as a fuel. An attempt was made to use acetylene as a fuel, but the torch flame proved to be unstable.

In Fig. 3, a linear correlation is shown between the total light output in lumens versus the illumination measured at an angle of 84.3 degrees. An identical relationship was found at an angle of 95.7 degrees. The equations of the lines are given in eq.1 and 2 and are listed below:

Eq 1) TL = 4.369 (fc @ 1' @ 95.7 degrees)

Eq 2) TL = 4.437 (fc @ 1' @ 84.3 degrees)

With TL being the light output in lumens



Since the polar diagrams are symmetrical around the 90 degree point, this is to be expected. Similarly, for the angles of 72.5 and 107.5 degrees, combing the data yielded the following:

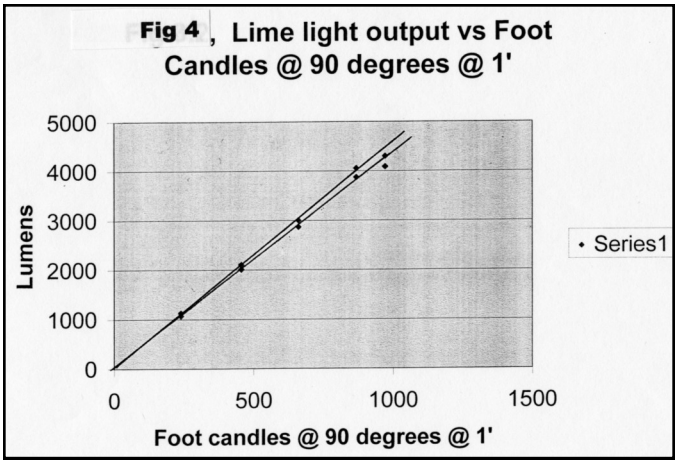
Eq 3 TL = 4.896 (fc @ 1' @ 72.5 and 107.9 degrees)

Note that the slope is now larger, since the measured illumination intensity values are lower.

Finally, a relationship was derived for illumination intensity at a value of 90 degrees was obtained which corresponded very closely to those at 84.3 and 95.7 degrees. These data are presented graphically in Fig. 4, and the equations of the linear correlations obtained are listed below.

Eq 4 TL measured = 4.383 (fc @1' @ 90 degrees)

Eq 5 TL corrected = 4.657 (fc @ 1' @ 90 degrees)



The Russell angle method is satisfactory only if at any given angle the path to the detector is not blocked by some structure in the lamp being studied. At 154.5 degrees, the torch body

appeared to do just such blocking, so in the corrected correlation, the value at 25.8 degrees was substituted. The difference between the slopes in equations 4 and 5 is only about 6% and probably can be ignored. The utility of equations 4 and 5 is that they can be used to convert historic "candle power" data to the modern context of lumens. Considering that historic standard candles varied as much as ± 20%, the differences between eq, 4 and 5 are of no real importance. In Table I, a comparison of historic "candle power" ratings for magic lantern limelights, their conversion to lumens, and actual measurements taken in the course of this work are presented. Note that the higher calculated light values from published data agree well with those found in the present study. I think we can safely state that a mixed jet lime light used in a magic lantern probably was good for no more than about 4000 lumens. With the use of a modern National brand torch and a flat rather than a cylindrical lime, I was able to obtain a light output of over 6000 lumens, although it is doubtful if this level of output could be maintained for any length of time.

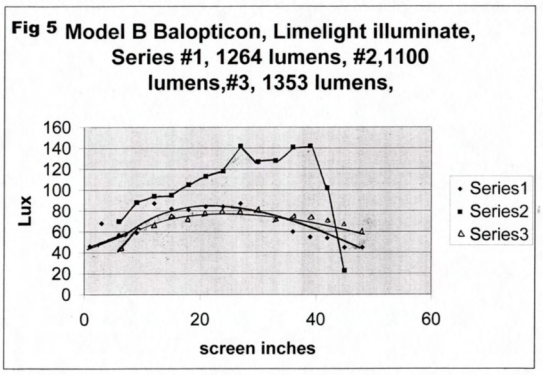
Table 1. Limelight output comparisons of published measurements and measurements from my work.

Burner	Gas flow RCFH	Gas	Lumens meas.	Lumens calc. eq4	Notes
Historic—this work	0.75	propane	1072		
	1.0	propane	2013		
	1.0	propane	2144		
	1.0	propane	2870		
	1.0	propane	3363		
	1.0	propane	3243		
	1.0	propane	3243		
	1.0	propane	3283		
	1.5	propane	3287		
	2.0	propane	4040		
		Alcohol		219	Blow through (6)
		Common gas		438	(6)
		Hydrogen		548	(6)
Blow through		"gas" H_2?		1753	(6)
		"gas" H_2?		2192	(6)
Mixed jet		"gas" H_2?		3506	(6)
		"gas" H_2?		3944	(6)

Note: Measured lumens vary even with the same flow rate and fuel because of variation in the condition of the lime.

Although we now have reasonable estimates of the light output of the limelight, the question remains as to how much of it was available on the projection screen. Given the highly variable light output of the limelight even at a single fuel gas flow, it was felt necessary to first measure the screen brightness and then in turn measure the light output. A Bausch and Lomb Model B Balopticon was admirably suited to this task, as the carbon arc light source with which the lantern was supplied is easily removed directly exposing the rear condenser lens. A movable platform was contrived so that this lantern without its light source could be positioned in front of the limelight when clamped in the photometric measuring apparatus. For these measurements, no slide holder or mask was present, so the screen presented the full image of the condenser system, which consisted of two plano-convex lenses 4.11 inches in diameter, 11/16 inches thick in the center, and spaced 1.71 inches apart as measured from the edges. The two flat lens surfaces faced the light source and the projection lens respectively. The projection lens was a 10 inch f# 6.6.

The procedure used was to adjust the limelight and quickly align the lantern. A screen image of 47.5 inches was projected on a screen about 13 feet away, and the illumination across the screen measured at 3 inch intervals. The data for three such runs are presented in Fig. 5. The series 2 data were anomalous. Such problems occasionally occurred, especially as a single lime was used in all these studies, and as the work progressed the lime became cratered, cracked, and broken. The lantern experiments were the last undertaken, and the lime was in rather poor shape by this time.



Once the screen measurements were taken, the lantern was removed from the platform and the Russell angle method used to measure its output in lumens. The limelight intensity was deliberately kept low to try to insure that the light output would remain stable. It was found possible to perform all the measurements in about 5 to 7 minutes, including the alignment of the lantern. Table II presents the results of four trials that were deemed reliable.

Table II. Screen illumination using limelight and a Balopticon. Screen circle was 3.958 feet.

Trial	Lumens	Screen fc.	Lumens avail	Lumens thru slide	% lumens
1	1100	5.9	72.6	40.7	3.7
2	1264	6.2	76.3	42.7	3.4
3	1998	3.7	45.3	25.4	2.1
4	1353	6.5	79.8	44.7	3.3

Table II reveals that, with the exception of trial 3, the amount of light available to illuminate a 3-inch diameter wood mounted circular slide was only about 3.5% of the total**.** Using this value, the screen illumination using a 4000 lumen limelight is presented in Table III for the Model B Balopticon.

Table III. Screen illumination calculated for the Model B Balopticon Using a 4000 lumen limelight and a 3 inch diameter mask.

Circle diameter	8’	12’	15’	20’
Average fc on screen	2.7	1.24	0.8	0.44

As can be seen in Table III, screen illumination is well below the 4-10 foot candles which is considered desirable today. It also should be remembered that in an age of gas and oil lamps, audiences were probably much better dark adapted than modern ones. Gage (5) stated that lime light outputs were about 1/3 – 1/6 the light output of a carbon arc, so multiplying the fc values in Table III by 3 - 6 gives values in about this range, except for the 20-foot circle. Similar results were calculated from the measured transmission factors of a late 19th century Perk, Raiment & Son’s lantern, which was definitely used with limelight.

How large a screen area did Victorian lantern lecturers generally illuminate? Hepworth[8] stated that the screen at the Royal Polytechnic Institution was 26 feet wide, and reference to an illustration in Pepper’s *The Boy’s Playbook of Science* (1866) suggests that the images were 23 to 25 feet high. There were as many as six lanterns in use during a single show at the Polytechnic, and they all were very large and used large slides, in conjunction with 11-inch diameter condensers and projection lenses of “superior quality.” An Arc light, no doubt battery powered at this date, was used with a mirror arrangement so that it could be used with two lanterns in addition to limelights. This probably represents the upper limit in Victorian lantern screen size. Hepworth also stated that a 15 x 15 foot screen was the largest that most halls could accommodate, with a few accepting 18 x18 foot. Thus probably a 15 foot circle was the largest that was usually projected.

Use of a 200W FEV bulb in the Model B Balopticon resulted in only about 1.4 - 1.5% of the available light (5500 lumens) being projected onto the screen to illuminate a 3-inch diameter wood mounted slide. This is roughly ½ of the values for the limelight given in Table II. This is to be expected, because the limelight directs all its light in a hemispherical envelope and thus towards the condenser. The FEV bulb illuminates in all directions and hence directs its light in spherical envelope. It should be noted that a spherical mirror behind this lamp will raise its output in theory by a factor of two, but in practice probably closer to one-third.

With respect to the type of fuel gas used with the limelight, inspection of modern values of flame temperature reveal relatively small differences.[9] Thus the maximum flame temperature obtained with an oxygen and hydrogen torch is 2660°C, carbon monoxide 2925°C, acetylene 2927°C, natural gas (methane chiefly) 2930°C. Since the limelight is an incandescent light source, the amount of visible light given off should increase as the temperature approaches about 5000°C. In practice, differences were observed however. Hepworth reported that a lantern exhibition at the Crystal Palace suffered when illuminating gas was substituted for hydrogen and that people who were competent to judge felt that a 25% reduction in light output resulted. Victorian British illuminating gas was made by heating coal in large iron retorts to high temperatures, and the resulting “ coal gas “ was a complex mixture of carbon monoxide, hydrogen and other components. The 25% difference noted is in rough agreement with the 19% difference in flame temperature between hydrogen and anthracite coal gas (producer gas) when burned in air. Similarly difference in the nature of the lime or lime substitute should have little effect as long it can withstand the temperature to which it is heated. The light output is chiefly dependent on the temperature of the emitting element .

In conclusion this work supports the conclusions presented earlier[1] that magic lantern shows were presented in the limelight era using light levels much below those deemed acceptable in the modern motion picture theater. Only the carbon arc light was capable of truly high screen illumination until incandescent lamp technology developed to the point that moderately high levels of screen illumination could be achieved. Even so, for theater picture presentation, be it slide or motion picture, carbon arc lamps were the only source of light of adequate intensity for at least the first three-quarters of the 20th century. Union Carbide Corporation, which was the chief supplier of arc light carbons in the USA, had an active research program in carbon arc light technology at least into the early 1960s.

The modern motion picture theater projector uses a Xenon high pressure arc lamp run on a current draw of on the order of 100 amps. These look like slim oddly-shaped light bulbs. The modern trend is to do away with film entirely and employ digital technology. The “film” arrives at the theater on a hard drive enclosed in a case about the size of the now obsolete VHS cassette. The film is transferred to the projector via a USB port, and once that is done all the operator has to do is press a button to start the show. Times have changed!

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Appendix I: Method of Russell Angles

As has been mentioned earlier if the light source can be assumed to be a point source a single measurement of distance and illumination (fc) will suffice to determine the total light flux (lumens). However this is seldom the case in practice with real light sources. If the light source is symmetrical measurements in a single usually vertical plane can be used to generate a polar diagram of illumination (fc) versus angle. Such diagrams are shown in figure 1 for the lime light used in this study. In figure 1 the source is considered to be at the origin and the length of each radius vector represents the luminous intensity. The radii are vector quantities because they posses both a magnitude and a direction in contrast to scalar quantities, like weight and temperature, which posses only magnitude. The total Luminous flux (TL) is not merely the area under the polar curve, but is given by the expression:

Eq. 1) $$TL = \int_0^{2\pi} \int_0^{h} I_\theta \, d\theta \, d\phi$$

Since I_Θ is independent of Φ :

Eq.2) $$TL = 2\pi \int_0^{h} I_\theta \sin\theta \, d\theta$$

Equation 2 may be solved by several approximate methods but perhaps the simplest is due to Russell (3). Measurements are made a series of angles given by the relationship:

Eq.3) $\Theta_x = \cos^{-1}(\pm x/2n)$

For a set of 2n angles for values of x of 1, 3, 5,……2n-1

Thus for the value of n = 5 used in this study the following angles are generated,

X value	Θ value, degrees	
1, -1	84.26	95.74
3, -3	72.5	107.45
5, -5	60	120
7, -7	45.57	134.43
9, -9	25.84	154.16

In practice the angles are rounded off to the first decimal place. All one does is to measure the illumination (fc value) at a known distance in feet from the light source under study at the appropriate Russell angles and at a distance great enough that the inverse square law may be applied. The values of illumination obtained at all the angles in the chosen series, in this case 10, are averaged and this average multiplied by the square of the distance from the fc meter to the source. This value, if the light is irradiated in all directions is multiplied by 4π if, as in the case of the lime light, the light illuminates over a hemisphere the appropriate factor is 2π.

It is important to note that the angles are measured vertically downward from zero and in a plane which passes through a vertical axis of symmetry of the source. Hence the necessity of mounting the limelight on its side in this study. If more than one such plane exists additional measurements must be made and the results averaged. This problem along with the method of Russell angles is discussed in detail by Walsh.[3]

Magic Lantern Society member **John Davidson** is a scientist and engineer with an interest in the history of science and technology. He was employed by the B. F. Goodrich Company, where he produced a number of informational films. He started making scientific apparatus in high school and has been a working glass blower for more than 55 years, not only for scientific purposes, but for neon signs and Christmas tree ornaments.

The Research Page provides short summaries of recent academic research articles on magic lanterns and related subjects. This Research Page focuses on Latin American and Spanish perspectives on the magic lantern.

Alice Dubina Trusz. 2010. O cruzamento de tradições visuais nos espetáculos de projeções ópticas realizados em Porto Alegre entre 1861 e 1908. ***Anais do Museu Paulista: Historia e Cultura Material*** **18 (1):129-178.**

This lengthy and detailed article by Brazilian historian Alice Dubina Trusz is based on her Ph.D. dissertation, "*Entre lanternas mágicas e cinematográfos: as origens do espetáculo cinematográfico em Porto Alegre, 1861-1908",* recently published in book form by the Audiovisual Secretary of Brazilian Federal Government after being named as the best dissertation on film studies in Brazil in 2009.

The importance of Trusz's work is unquestionable, since the study of pre-cinema and particularly magic lantern history in Brazil is just beginning. The difficulties, however, are formidable. Most studies on early cinema in Brazil have been based almost exclusively on research in newspapers, because very few films from that period (1898-1910) have actually survived. Trusz's research on magic lantern shows also depends heavily on extensive research in contemporary newspapers. There are no specialized film museums in Brazil, and the two main Film Archives in the country have minor collections of pre-cinema artifacts.[1] I have heard of great objects in the hands of private collections, but they are not publicized, and I think that most Brazilian collectors do not even know each other.

Focused in the city of Porto Alegre, located in the south of Brazil and known for its intense German migration in the 19th century, Trusz's work notes the frequent presence of magic lanterns (*lanternas mágicas*) and optical boxes (*caixas de óticas*) during the second half of the 1800s, pointing out that the both media were frequently described incorrectly by the press of that time. Some of the names used by the itinerant exhibitors were "cosmoramas" and "cycloramas." In Porto Alegre, the public projection of magic lantern shows dates to 1861, although there never were specialized and fixed theaters for that kind of show. In most cases, the magic lantern was a complement to itinerant shows of illusionism and prestidigitation. Travel and artistic views were the kind that the public most enjoyed. The shows were not handled by professional lanternists, but by Brazilian and foreign lecturers who included Porto Alegre in their itinerant tours.

Only twice were the spectacles described by the local press as a *magic lantern* show–in 1880 and 1897, both times with the purpose of criticizing a show that was considered no better than a domestic magic lantern projection. More frequently, exhibitors used exotic names to appeal to audiences: Egyptian Megascópio, Phantasmagoric Poliorama, Electric Poliorama, Universal Poliorama, Silforama, Diafanorama or Diaforama, and Gigantic Kaleidoscopic. The Porto Alegre press called attention to spectacles that used "dissolving" (*dissolventes*) views, indicating the use of magic lanterns with two or three objectives. Most of the article is dedicated to the description of the main magic lantern exhibitions that happened in Porto Alegre between 1861 and 1896. Exhibitors included the French-British Dr. Mailhor Lohlian (1875), A. J. D. Wallace (1878), the German professor David J. Hofmann (1880), Henrique Lavigne (1882), Count Patrizio de Castiglioni (1880, 1883 and 1887), and many others.

In 1896, projected moving pictures were first shown to the porto-alegrenses, and from that moment on, magic lantern views started to be called "fixed views (*vistas fixas*) to differentiate them from "animated views or photographs" (*fotografias animadas* or *vistas animadas*). Trusz indicates that the traditional fixed views often were projected together with films by the first itinerant cinematographers. However, they were not projected between the changes of film reels as in the United States, for example, because exhibitors usually had only one projector. Instead, the fixed views were seen as an extra attraction to the show, and, because of that, the exhibitors had to improve the quality and size of their collections of slides. The most interesting point of the article is the identification of portraits of historical and political local personalities as the most frequent subjects of such shows. The photographers had the ability to produce these slides themselves, although some were purchased, and the public was delighted to applaud or to scream at the slide depending on what figure was represented, either a member of the government or of the opposition political party. The exhibitors obviously were concerned about the "thematic actuality" of their fixed views, even if sometimes they were only illustrated and not necessarily photographed. By 1907-1908, with the installation of the first movie theaters in Porto Alegre, interest in magic lantern shows declined.

I hope the brilliant work of Alice Dubina Trusz helps to stimulate interest in the magic lantern in Brazil, at least in our academic community.—**Rafael de Luna Freire.**

1. A great part of the magic lantern collection of the Cinemateca Brasileira in São Paulo was lost or damaged in the fire that destroyed most of their collection of nitrate films in 1957. The Cinemateca do Museu de Arte Moderna do Rio de Janeiro was the repository of a state collection of cinema and old pre-cinema equipment (collected and donated by the cinematographer and researcher Jurandyr Noronha), but it was robbed in the 1980s and the items probably sold to foreign collectors. Today, the Cinemateca do MAM has only one fine example of a magic lantern in its collection.

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Brendan Lanctot. 2009. El gabinete óptico da la idelogía: visualidad y política en la época de Rosas (1829-1852). *A Contra Corriente* 7 (1):91-110.

This article addresses both the presence of optical devices such as magic lanterns and peepshows in Argentina in the early 19th century and the use of optical metaphors in writings of the period. Taking a cue from Jonathan Crary's well known book, *Techniques of the Observer*, Lanctot argues that the use of these optical devices indicates the beginnings of a visual culture in Argentina and a "new way of seeing" that was important in the formation of a national identity in the years when Argentina was emerging from colonial rule. Using contemporary letters and newspaper accounts, the author shows that various optical entertainments appeared in Argentina from the 1820s through the 1840s. These included peepshows or optical boxes ("*tutilimundi*", defined by the dictionary of the Spanish Academy as "a large box that would contain a portable cosmorama or a collection of moving figures that was carried through the streets for people's entertainment"), magic lantern shows, and even a phantasmagoria presented by the Italian showman Felix Tiola. The author gives examples of optical metaphors from a variety of political and non-political writings of the period, including "Visiones de la óptica," a short fictional piece written in 1838 by Andrés Lamas, the editor of a short-lived newspaper that spoke for dissidents and critics of the dictatorial regime of Juan Manuel de Rosas. The story features a man who travels with an optical box that reveals a succession of rapidly-changing views of a utopian society, a sort of illusion during a period of repressive rule by Rosas. Overall, this article provides an interesting and little explored South American perspective on 19th century visual culture, of which magic lanterns were an important part. [Brendan Lanctot teaches at The University of Puget Sound; he kindly provided the text of a talk delivered in English that is a modified version of his published article, greatly facilitating my understanding of his paper.]—**The Editor.**

José Antonio Rodríguez. 2009. *El Arte de las Ilusiones. Espectáculos Precinematográficos en México*. Testimonios del Archivo, Mexico City.

I imagine that most members of our society are not aware that a book-length treatment of the history of magic lanterns in Mexico has been published recently. Actually, this book goes beyond magic lanterns to discuss other forms of optical spectacles such as dioramas, cosmoramas, and panoramas. Although the author uses some rather dated secondary sources, such as Martin Quigley's *Magic Shadows* (1948) and C. W. Ceram's *Archaeology of the Cinema* (1965), the real value of the book is the many primary source materials used to reconstruct the history of optical entertainments in Mexico, including contemporary newspaper accounts and government documents such as applications for permits to present shows in various cities.

One of the most astonishing results of the author's research is evidence that knowlege of the magic lantern spread to Mexico very early. Although Americans tend to view Mexico in the 17th century as a colonial backwater (as was much of North America at the time), in fact, Mexico was the center of a wealthy Spanish empire in the New World, with regular access to European books and ideas. The author quotes from extensive correspondence between Athanasius Kircher and Father Favián in Mexico starting in the 1660s to show not only that Kircher's books were circulating in Mexico at the time, but individuals in Mexico were in direct contact with Kircher. In fact, Father Favián was putting together his own personal museum, modelled on Kircher's museum, although no trace of his museum remains today. Favián not only received copies of Kircher's books directly from the author, but also other books that described the magic lantern, including Gaspar Schott's *Magia Universalis Naturae et Artis.* He also received packages from Kircher containing scientific instruments. Apparently Favián intended to write his own book summarizing the knowledge of authors such as Kircher and Schott, but the book either was never published, or has been lost. Favián was not the only person in Mexico familiar with Kircher's work on the magic lantern. Sister Juana Inés de la Cruz, an important figure in 17th century Mexican science and literature, was schooled in Kircher's work and even wrote a poem in the 1690s in which she anticipated phantasmagoria-like ghost effects created by the magic lantern and compared them to fleeting images created by the brain.

Rodríguez goes on to trace the history of the magic lantern and other optical devices in Mexico through the 18th and 19th centuries. Certainly by the late 1700s, magic lanterns were familiar to people in Mexico and were used to project images. The author gives as an example a "Cabinet of Natural History" opened in Mexico City in 1790 by José Longinos Martínez, in which scientific instruments were exhibited, including camera obscuras and magic lanterns. The author also uses newspaper announcements and library records to show that French and Spanish books describing magic lanterns were being imported into Mexico in the late 18th and early 19th centuries. The author uses contemporary newspaper descriptions, applications for show permits, and other documents to reveal a thriving culture of magic lantern shows, phantasmagorias, grand stereopticons, panoramas, cosmoramas, and dioramas in 19th century Mexico. Exhibitors included both Mexican and foreign showmen. The book includes numerous interesting illustrations of lantern shows, lantern slides, and newspaper announcements of various kinds of shows. All of this information is new and makes an extraordinary contribution to our understanding of magic lantern culture in a region that has been little studied. —**The Editor**.

Thanks to Terry Borton for providing me with a copy of this book, and to my wife, Marta Martínez Wells, for help with Spanish translation.

Carmen Luz Maturana. 2009. La comedia de magia y los efectos visuals de la era pre-cinematográfica en el siglo XIX en Chile. *Aisthesis* no. 45:82-102.

This wonderfully researched article provides a detailed summary of the Comedy of Magic in 19th century Chile. This theatrical form, essentially carried over from European Baroque theatrical productions involving a variety of stage tricks, optical effects, projected images using the magic lantern, ghost effects, and other pre-cinematographic techniques, persisted in Chile until the advent of motion pictures. Using announcements from contemporary newspapers and other sources, the author gives a chronological history of all sorts of optical effect shows in Chile, from the 1820s to the end of the 19th century, including magic lantern shows with dissolving views, phantasmagorias, panoramas, and other sorts of "physical and chemical magic." Many of these shows were presented by European showmen, stage magicians, or theatrical companies. These individuals and groups traveled throughout South America, appearing not only in major cities in Chile such as Santiago and Valparaiso, but also in Bolivia, Peru, Argentina, Uruguay, and Brazil. An early exhibitor in the 1820s was an Italian, Felix Tiola, whose phantasmagoria-like show provoked outrage from the local authorities in Santiago, who considered this sort of entertainment an insult to public morality and called for such shows to be banned.—**The Editor.**

Rafael Gómez Alonso. 2002. La comedia de magia como precedente del espectáculo fílmico. *Historia y Communicación Social* 7:89-107.

This paper, published several years before the previous one, traces the history of the Comedy of Magic in Spain to the early 17th century, well before the magic lantern was invented. Again, the focus is on dramatic productions that involved a lot of special effects and visual and optical tricks, including those produced by the magic lantern. The author points out that the popularity of this form of drama peaked in the late 18th and early 19th centuries, at the time when phantasmagoria and other ghost shows were in vogue, as were gothic plots and scenery involving castles, graveyards, abandoned houses, and other spooky locations and scenes that included devils, ghosts, and spirits. In the early 19th century, various kinds of transformation scenes were particularly popular. Some of these may have been produced by projections from the magic lantern, but others involved screens or curtains with different scenes on the two sides, large transparencies, lighting tricks, thunder and lightning effects, mirrors, and other devices. Magicians, clowns, ghosts, and dream sequences also figured into these dramas. The author sees all of this as anticipating the early fantastic and science-fiction films by George Meliès and others, many of which relied on the same sorts of bizarre transformations and visual tricks, made somewhat easier to produce with the invention of the motion picture camera—**The Editor.**

Germán Labrador Méndez. 2007-2008. La televisión del siglo XVIII. Retablos de maravillas y linternas mágicas en un pronóstico de Torres Villarroel y un dibujo de Goya. *Revista de Erudicion y Critica* 4:75-86.

This paper deals mostly with references to peep shows (tutilimundi) and magic lanterns in the writings of Diego de Torres Villarroel (1693-1770), a prolific Spanish writer, priest, scientist, and professor, along with some comments on a rather bizarre peepshow painting by Goya. Torres mentions the arrival of a traveling showman in Salamanca in 1730, equipped with a peep show box depicting a variety of marvelous scenes of shipwrecks, battles, processions, etc. In his writings, Torres made use of optical metaphors to comment on political and religious issues of the day. He also describes a magic lantern show presented by a traveling showman, probably a Savoyard, speaking a language that is neither Italian, French, nor German. As slides show processions of people, the showman makes satirical comments, stating that there were crazy people in the past and in the present, and decrying the hypocrisy of a world still filled with imposters, liars, and tyrants.—**The Editor**.

This paper was somewhat difficult for me to read, because it is written in a formal academic style of literary criticism. Thanks to my wife Marta for help with translating the Spanish.

Diego de Torres Villarroel (1693-1770)

Germán Labrador Méndez. 2008. Las luces figuradas: Imágines de dispositivos tecno-científicos y secularización en la España del Siglo XVIII: retrados, linternas mágicas y globos. *Cuadernos Dieciochistas* 9:49-78.

This somewhat complex article examines popular images of technological innovation in 18th century Spain to understand the interactions between modern science, Enlightenment politics, and popular culture. The author refers specifically to portraits of contemporary scientists, illustrations of magic lantern shows, and illustrations of hot-air balloon ascents to support his argument. Magic lanterns often were included in illustrations of cabinets of scientific instruments, including camera obscuras, and were considered a new and marvelous sort of invention. The author sees contrasting reactions to magic lanterns among intellectuals and the political elite. On the one hand, there was fascination with the ability of the magic lantern to produce images of a new reality through technology. On the other hand, magic lantern shows often were criticized and even censored by the church or political leaders on the grounds that they tended to appeal to the lower classes of society and often contained rather gross, profane, or satirical critiques of society. Traveling peepshows (tutilimundi) came in for similar criticism —**The Editor.**

Thanks to my wife Marta for help with some difficult Spanish passages.

Francisco Javier Frutos Esteban. 2008. Las proyecciones audiovisuales mediante linterna mágica como objeto de studio. *Tripodos* no. 23:161-176.

The general thesis of this paper is that optical projection by means of the magic lantern has been little studied, meriting only brief notices in standard histories of media or communication. The author then sets out to provide a summary of the current state of magic lantern research, mostly as a guide for Spanish scholars interested in this field. He discusses the origins of The Magic Lantern Society in Britain and some of the society's key publications, including its journal and the *Encyclopedia of the Magic Lantern*. Unfortunately, no mention is made of the Magic Lantern Society of the United States and Canada, or our journal. He also refers to other works, such as Laurent Mannoni's *Great Art of Light and Shadow* and a few other monographic works on cinema history, including one in Spanish and one in Catalan. He also briefly describes the field of visual studies, with such key works as Jonathan Crary's *Techniques of the Observer*. He makes little reference to the scholarly journal literature on magic lanterns, including work published in Spain, but his short summary somewhat belies the claim that magic lanterns have been little studied. In fact, academic interest in magic lanterns and other optical devices is growing rapidly in many countries. The article is illustrated with a number of interesting pictures of magic lantern shows, mostly from French and English sources.—**The Editor.**

Francisco Javier Frutos Esteban. 2009. Historietas mágicas: Orígines del relato gráfico y proyección de imágenes. *Diálogos de la Communición* no. 78:1-11.

This article explores the relationship between printed cartoons and comic strips and projected cartoons on magic lantern slides. The author maintains that the connections between these media have been neglected by previous researchers, but that the motivations behind printed and projected cartoons were very similar. He uses a broad definition of cartoons to include charicature prints, such as those of Thomas Rowlandson, James Gillray, and Gustave Doré, as well as religious and political cartoons and more recent newspaper comic strips. He provides a brief history of the magic lantern from Huygens through the phantasmagoria and the industrial mass production of lanterns and slides in the 19th century. Much of this history is not particular to Spain, but refers to developments in other countries, including the manufacture of lanterns and slides in England. The author then describes the use of magic lantern slides to illustrate narratives, often with cartoon-like illustrations, and draws parallels with published cartoons in newspapers and other print meda. The article includes a number of illustrations of magic lantern shows and lantern slides, including a British set on Alice in Wonderland.—**The Editor**.

Antonio Lorenzo Tena. 2007. De la linterna mágica al soporte digital: breve sinopsis histórica sobre la evolución del cinema en La Palma. *Cartas Diferentes. Revista Canaria de Patrimonio Documental* no. 3:153-179.

This article provides a brief history of the cinema in La Palma, one of the Canary Islands, and is published in a journal devoted to the history of the islands. Despite the presence of the magic lantern in the title, there is only a brief discussion the magic lantern as an antecendent of the cinema. There also is some mention of peepshows, including one shown in La Palma. The author briefly mentions the presence of a magic lantern show in La Palma in 1824, but there is not a detailed history of magic lantern shows on the island. Most of the article is concerned with the history of cinema on the island, starting with the exhibiton of Edison's kinetoscope in La Palma in 1897 and the arrival of projected movies in 1898. So even in this remote part of Spain, motion pictures were available within a few months of their first showing in major European countries. The article includes one illustration of a magic lantern show and one of a peepshow from a Spanish source. —**The Editor**.

Luis Miguel Fernández. 2006. Tecnologiá, Espectáculo, Literatura. Dispositivos Ópticos en las Letras Españoles de los Siglos XVIII y XIX. Universidade de Santiago de Compostela.

This is a work of remarkable scholarship that seems to have gone unnoticed by non-Spanish scholars of the magic lantern, and even some Spanish-speaking authors (for example, it is not cited in the book on the magic lantern in Mexico by Rodríguez, which was published several years later). The main focus of the book is the influence of various sorts of optical displays and spectacles, including magic lantern shows, on Spanish literature in the 18th and 19th centuries. First, however, the author provides a rather detailed account of the history of the magic lantern and other optical devices in Spain, starting in the 17th century. As in other European countries, magic lanterns in the 17th century were mostly considered scientific instruments, associated with "cabinets of physics" assembled by leading scientists. Knowledge of the magic lantern entered Spain very early, and the author shows that Spanish scientists and writers of the 17th century and early 18th centuries either owned or cited important early accounts of magic lanterns, including those of Kircher, Schott, Sturm, Zahn, Nollet, Musschenbroeck, and Gravesande. One illustration in the book is the title page of Zahn's *Oculus Artificialis* (1702), from a copy that belonged to Father Benito Jerónimo Feijoo (1676-1764), a Spanish monk and scholar who encouraged scientific enquiry while fighting against superstition, myth, and magic. In his masterwork, *Teatro Critico*, Feijoo wrote at some length about the marvelous ability of the magic lantern to project images. Other 18th centuries authors, including Portuguese scientist Teodoro de Almeida and Bernardo Monton of Madrid, also wrote about magic lanterns in scientific books.

Fernandez devotes a full chapter to the history of experimental physics and optics in 18th century Spain, which was heavily influenced by developments in other parts of Europe, especially France. As in other European countries, Spanish scientists acknowledged that magic lanterns often were put to ridiculous and vulgar uses, but also recognized their importance as optical instruments.

Another chapter deals with the variety of visual spectacles found in Spain in the 18th and 19th centuries, including magic lanterns, phantasmagoria shows, peepshows, optical boxes, Chinese shadows, transparent paintings, panoramas, dioramas, and cosmoramas. As was often the case in other countries, contemporary accounts of visual attractions can be confusing, with terms often being used interchangeably, and magic lantern shows often conflated with other kinds of attractions. What is impressive is the sheer number of visual attractions available to the Spanish public in the 18th and 19th century, many of which found their way into Spanish literature as metaphors for vision or imagination. The author discusses various technical improvements to the magic lantern, most of which were not peculiar to Spain, including advances in lighting and the development of the phantasmagoria and dissolving views in the early 19th century. In this chapter, and in a later one discussing the influence of the phantasmagoria on literature, the author gives a good deal of detail on the arrival of the phantasmagoria in Spain, including shows given by Robertson in Madrid in 1821. Unfortunately, here the author seems to have missed important scholarship on the phantasmagoria by non-Spanish authors. He cites the French edition of Laurent Mannoni's 1995 book, but does not mention articles on the phantasmagoria, many published in *The New Magic Lantern Journal*, by David Robinson, Mervyn Heard, Hermann Hecht, and others. Even Wendy Bird's work on Robertson's phantasmagoria in Madrid is not mentioned; only work by Varey from the 1950s is cited. Also missing is any reference to studies of the phantasmagoria and literature by authors such as Terry Castle and Marina Warner. Nevertheless, there is a lot of interesting material on the phantasmagoria from Spanish sources. The author also goes into considerable detail about Savoyards and other traveling showmen, although the placement of this material after the discussion of the phantasmagoria and dissolving views puts it somewhat out of chronological order. References to traveling showmen with magic lanterns or peepshows are common in Spanish literature and art of the 18th and 19th century, and the author gives many examples that I cannot discuss in detail here.

The second half of this book is devoted to the use of optical imagery and visual metaphors in Spanish literature from the 18th and 19th centuries. My lack of familiarity with many of the Spanish writers makes it hard for me to summarize this part of the book in detail. Nevertheless, the author has assembled a remarkable number of examples from well-known and obscure writers. In fact, this is one of the most complete surveys of this type that I have seen in any language. Other authors have addressed the use of optical metaphors and imagery, including references to magic lanterns, in gothic novels or Romantic poetry, but the survey of Spanish authors includes all of this, as well as the use of such metaphors by realist writers of the late 19th century. The author describes the fascination of 18th and early 19th century writers with ghosts, spirits, magic, and optical illusions. He devotes most of one chapter to the influence of the phantasmagoria on Romantic writers, and he discusses the many different meanings that became associated with the word "phantasmagoria" in 19th century literature. He also shows how metaphors of the phantasmagoria, magic lantern shows, and dissolving views often were used interchangeably to describe ephemeral visions, dreams, fleeting impressions on the mind, or other visual effects, such as views of a landscape passing by the windows of a moving train. For serious scholars of visual culture who can read Spanish well, this part of the book provides a rich and rewarding look at the interaction between optical technology and literature. I will be re-reading this part of the book several times.—**The Editor**.

Edward Curtis and "The Indian Picture Opera"

A Review by Terry Borton of Three Discussions of the Opera

Even if you don't know the name "Edward Curtis," the nineteenth-century photographer, you would recognize his work. He created those extraordinary sepia-tone photographs you've seen of American Indians. He also created one of America's most extraordinary magic-lantern shows.

Curtis (1868-1952) was born to a poor family and dropped out of school in sixth grade. He became fascinated with photography, built his own camera as a teenager, and began his career as a photographer just a few years later, eventually moving to Seattle, which became his home base.

In 1900 Curtis, acting as photographer, joined a scientific expedition to the territory of the Blackfeet Indians in Montana, and became fascinated with what he later came to call "A Vanishing Race." He felt that if the pre-contact culture of Indians was not documented at once, the chance would disappear. His growing scientific contacts eventually led him to become friends with Theodore Roosevelt, and through him he obtained a $75,000 loan from J. Pierpont Morgan to produce a 20-volume set of photographs entitled *The North American Indian* (The loan was to be paid back through the sale of the books to wealthy patrons). He took over 40,000 images of 80 tribes, and also produced 10,000 recordings of Indian language and music.

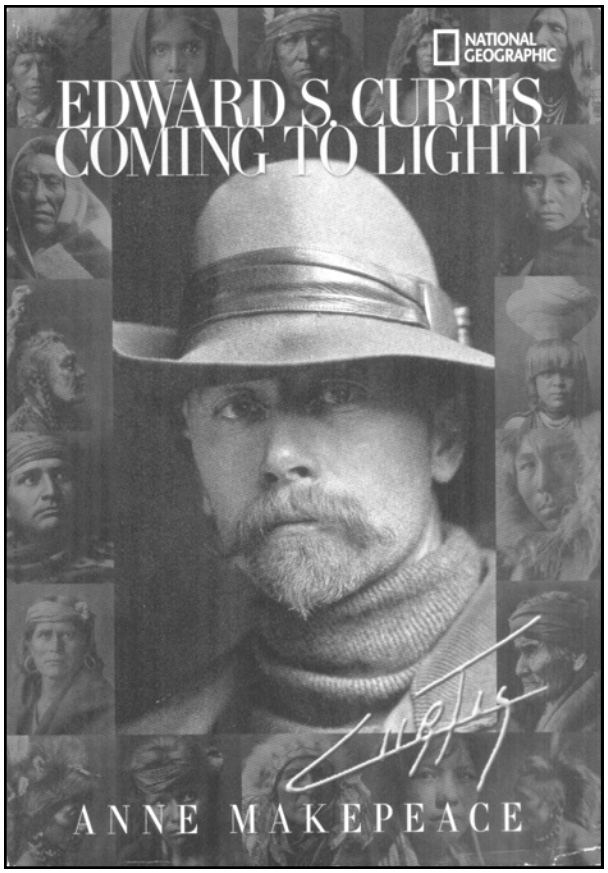
Two books and a DVD provide an excellent introduction to Curtis' work, and to his lantern shows.

Coming to Light

Edward S. Curtis: Coming to Light by Anne Makepeace, (Washington, D. C.: The National Geographic Society, 2002), is, as you might expect from its publisher, a beautifully presented collection of some of Curtis's best photographs, accompanied by an engaging and informative text. Curtis's early lantern presentations to his colleagues on the Blackfeet expedition are mentioned, as is his first public lecture (with lantern slides and movies) in Seattle's Christensen's Hall.

The book also gives us Curtis's discussion of the difficult fieldwork necessary to obtain his extraordinary lantern slides. Curtis discussed his travails in a lecture to a Seattle photography club in 1907:

"Our equipment weigh[s] from a thousand pounds to a ton . . . tents, bedding, our foods, saddles, cooking outfit, four to eight horses—such was the outfit . . At times handling of the material side of the work almost causes one to lose sight of the art and literature. . . .



"And then come the elements. The rain pours down. What was an arid desert when you made your camp is soon a lake. . . . At another time it may be the heat, so intense that a furnace seems cool in comparison—And on the other hand, it may be snow storms that will cause you to forget that you ever were warm."

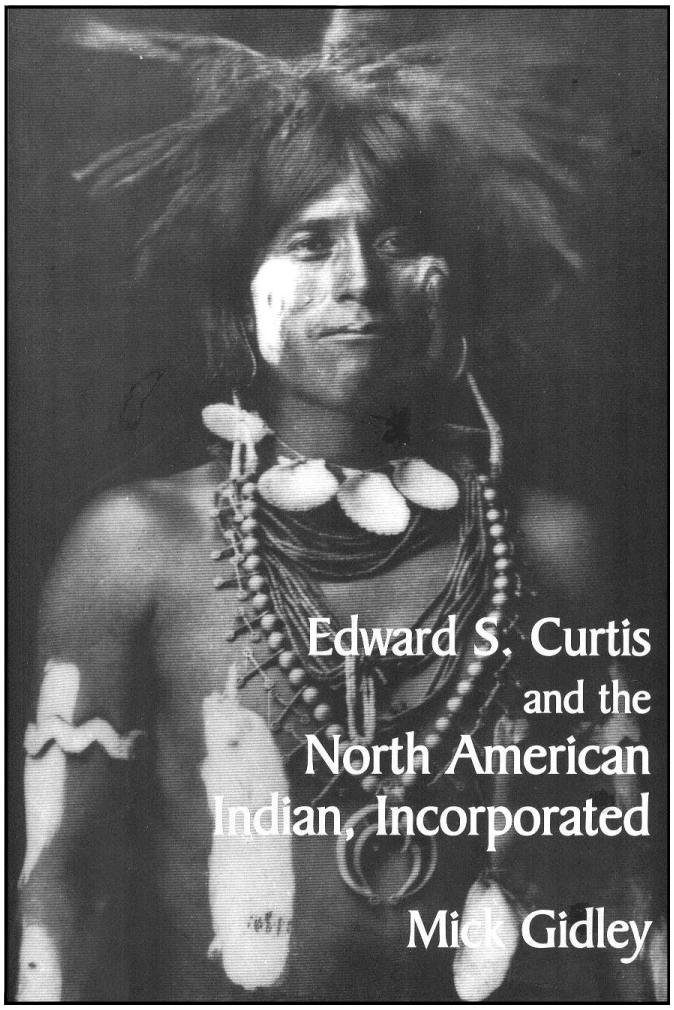
Coming to Light also gives a good introduction to what Curtis called his "picture musicale," or "The Indian Picture Opera"—a combination of his hand-colored lantern slides, motion pictures, words, and music. Curtis, of course, took the photographs and movies, but he also wrote the text. Henry F. Gilbert, a well-known American musician, composed the music (with Curtis's detailed guidance), based on the Indian music Curtis had recorded. Curtis's instructions to Gilbert give a lively sense of the musicale, and help us understand the care and artistry that went into achieving its effects:

"Quickly following the beginning of the music a sunrise scene will be thrown on the screen (slowly) . . Then the Vanishing Race [Curtis's iconic image], leaving it on the screen fully half a minute. . . Then we start with the South [Southern Indians], using an entirely new picture, perhaps of the palms [home to Indians who lived on palm nuts], then the Indians of Colorado . …… The closing scene will

be of the Arctic——a sunset over icebergs. In the music we want to carry the mood of the whole, well knit together, yet suggesting the local material."

Curtis introduced "The Indian Picture Opera" with a sold-out performance at Carnegie Hall in New York, and described the formidable schedule that followed: "On Monday I will lecture at Concord, NH, Tuesday at Manchester, Thursday at Northampton, on the tenth at Providence, thirteenth at Springfield, fourteenth at New Haven, and on the fifteenth at New York."

The purpose of "The Indian Picture Opera" was not just the musicale itself, but to gather further subscribers for Curtis's book series. In this objective it failed—only 222 complete sets were ever published. The complexities and costs of managing the tour of the musicale and paying the musicians were too much for Curtis, so the "Picture Opera" ran only for the 1911-12 season.



Edward S. Curtis … . Incorporated

Edward S. Curtis and the North American Indian, Incorporated by Mick Gidley (Cambridge, England: Cambridge University Press, 1998) is a much more academic book than *Coming to Light.* It deals with how Curtis "represented" the Indian, that is, created an image of a foreign culture that was not necessarily the culture itself. Gidley does not spend much time criticizing Curtis for the way he sometimes manipulated his subjects and the photographs themselves to get the effects he wanted, saying that there have been plenty of debunkers on that score. Instead, he focuses on the ways that Curtis's representation of the Indian was not simply the work of Curtis alone, but of a diverse group of people, a "corporation" of financiers, writers, editors, composers, musicians, lawyers, mule skinners, informants, translators, etc.

Of special interest to us here is a full chapter (Ch. 7) on the musicale, including a lengthy discussion of the role of the musician Gilbert. The chapter provides Curtis's own description of the audience reaction at Carnegie Hall: "The enthusiasm was quite out of the ordinary. During the impressive musical numbers you could sense the wave of feeling which passed over the audience. They would not cheer [then] as they wanted to hear to the best possible advantage."

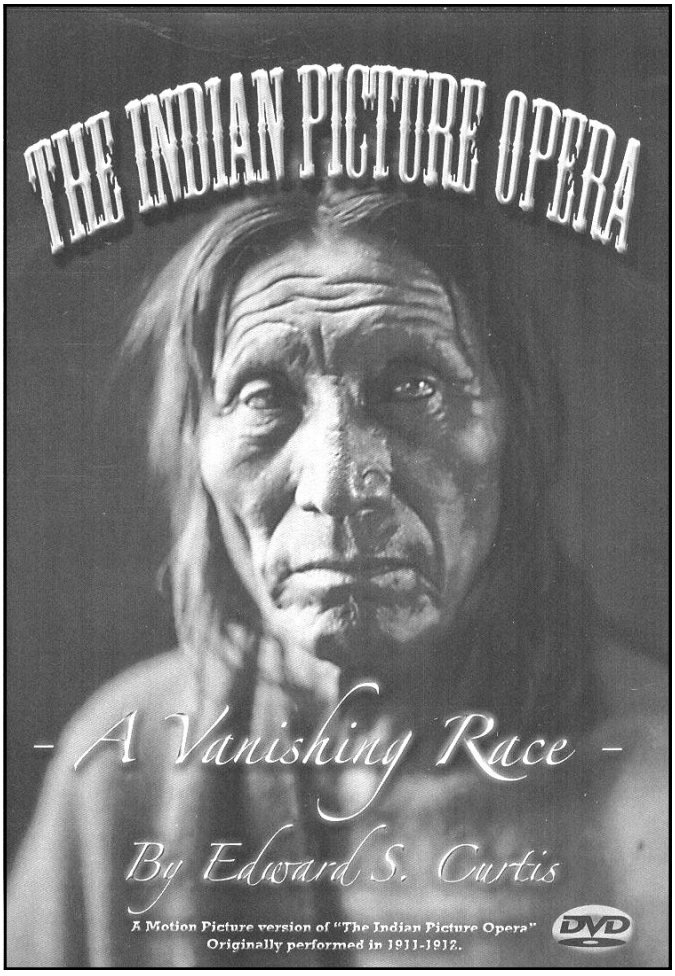
An especially useful feature of Gidley's book for magic-lantern enthusiasts is that it includes several "Documents"—original materials about the musicale reprinted in their entirety. Document 7A is "Program Notes for 'The Intimate Story of Indian Tribal Life, 1911. Document 7B is "Excerpts from a Typescript of a Script for the Musicale, 1911-12." Both give detailed descriptions of exactly how Curtis managed the slides, the "talk," and the music.

These extended comments make clear, as is suggested by the earlier instructions from Curtis to Gilbert, that the performance was tightly scripted, and artfully composed for maximum effect.

The Indian Picture Opera DVD

The third work of interest is a DVD, *The Indian Picture Opera: A Vanishing Race,* produced by Mosa Motion Graphics, LLC in 2006, and available through Amazon.

It purports to be a recreation of the "Picture Opera" and it does indeed include Curtis's pictures and text, Gilbert's music, a cameo appearance of David Francis's magic lantern, and a picture of a lantern show that was supplied by me. Unfortunately, the producers seem to have felt that the only way to hold the interest of a modern audience with Curtis's pictures was to use every available video gimmick to manipulate them. The pictures whirl, they fracture, they zip sideways and up and down, they flip and flop and dance. Almost never


THE INDIAN PICTURE OPERA
- A Vanishing Race -
By Edward S. Curtis
A Motion Picture version of "The Indian Picture Opera"
Originally performed in 1911-1912.
DVD

are you allowed to simply look at a Curtis picture—a dramatic contrast, for instance, to the way Ken Burns handled his Civil War images. This production of Curtis's *Indian Picture Opera* stands as an object lesson on how not to produce a re-created magic-lantern show, and, given the quality of Curtis's work, that is a terrible shame.

One of the disturbing things about the producer's approach is that it becomes almost impossible to tell what Curtis might have done, and what the producers added. That difficulty is compounded by the fact that the producers' lack of artistic sense is extended even to their actual re-creations of Curtis's effects, so that what was no doubt stunning on screen when Curtis created his art becomes a laughable parody in the re-creation.

Nonetheless, if you put on blinders to cut out the techno-freak, use a knowledge of how a talented lantern artists might have manipulated the slides using the then-available technology, and watch the video with the National Geographic book in hand so that you can remind yourself of the power of the Curtis images, you can guess at what the Picture Opera was like.

In particular, you get an inkling of why the enthusiasm of the audience was "quite out of the ordinary" during the "impressive musical numbers." Curtis set up these sequences with a brief introductory talk. What followed was a "dissolving series" of images accompanied only by music. One has to make some guesses here as to exactly what transpired, but in "The Signal Fire to the Mountain God" sequence, for instance, the series probably began with an evening image of a brave lighting a fire. Then the illuminant was lowered and darkness deepened. When only the dim silhouette remained the signal fire burned brighter (created with a superimposed fire effect), and then gradually burned down to embers as the superimposed light was lowered. Then, perhaps with a filter, the whole scene was re-lit anew in the glow of the morning sun. As a solemn interlude in the lecture, without a voice over, but instead with Gilbert's evocative music swelling to the forefront, "The Signal Fire to the Mountain God" must have been a very powerful moment.

Shows vs. Lectures

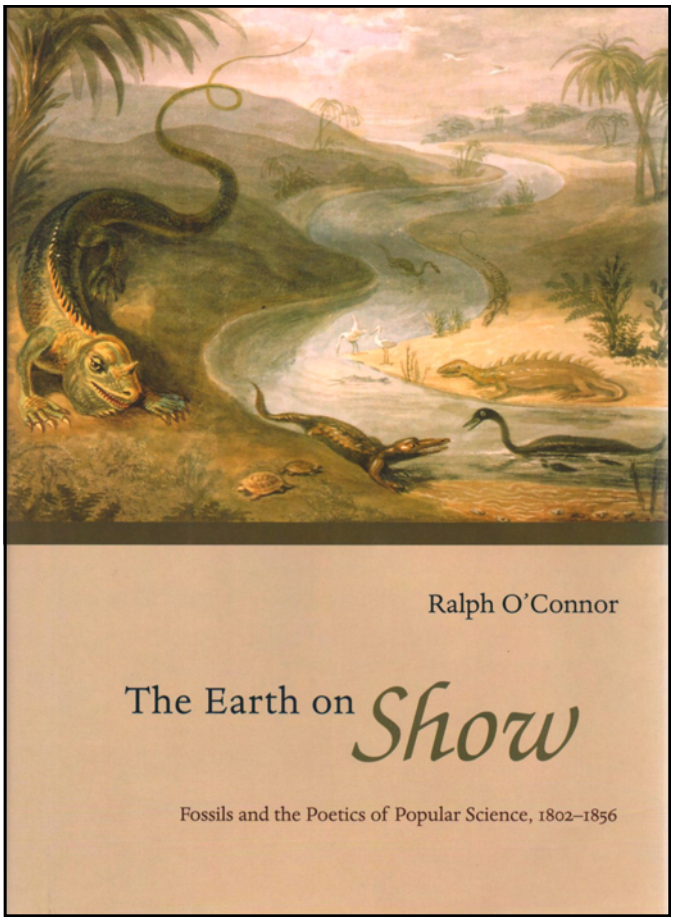
We tend to think of a division in the magic lantern world between "shows"—stories, songs, comics—and "lectures," and to assume that the later were somehow dry, dull, and lacking in artistic merit. Reviewing the lantern performances of Edward Curtis should remind us that a magic-lantern lecture also could have drama and beauty and subtlety, and could even move the soul.

Editor's Note: *Smithsonian Magazine* has produced a 4-minute video on Curtis's photographs, and in particular, a group of over 500 original glass and film negatives recently acquired by the Smithsonian from Curtis's grandson:

http://www.smithsonianmag.com/video/Edward-Curtis-Photographing-the-North-American-Indian.html

From a *Smithsonian Magazine* blog about the acquisition of these rare negatives (posted March 22, 2011):

It's extremely rare to find negatives of Edward Sheriff Curtis, the iconic photographer of Native American life and the Old West. And that's what makes Jim Graybill's gift to Smithsonian's National Anthropological Archives all the more exciting. Graybill, the grandson of Edward Curtis, recently donated his collection of over 700 Curtis glass negatives and positives, which includes over 500 original negatives, 432 of which have not been published. Curtis' photography served as an important historical record to capture a "romanticized" version of Native American culture as it was slowly disappearing, and his work culminated in an epic 20-volume project, *The North American Indian,* funded by J. Pierpont Morgan. In it, Curtis photographed and documented Native American life and traditions around the continent. He was not without his critics, however, for his manipulation of subjects and images. For the purpose of image "reality" and composition, Curtis at times posed Native Americans, had Native Americans re-enact ceremonies, or removed modern-day objects from photos.



Ralph O'Connor. 2007. *The Earth on Show. Fossils and the Poetics of Popular Science, 1802-1856.* University of Chicago Press, Chicago. ISBN 978-0-226-61668-1. 542 pp. $45.00 (hardcover).

I bought this book a couple of years ago because of my interest in the history of 19th century science, not realizing at the time that it contained a significant amount of material on magic lanterns, panoramas, and other sorts of visual exhibitions. In this well-researched and elegantly written book, the author describes the many ways in which the science of geology was popularized in the first half of the 19th century, through general audience periodicals, books, panoramas, dioramas, magic lantern lectures, and other forms of written and visual education. It is hard for 21st century readers to realize how popular geology was during this period—it was the premier "public science" in the early 19th century in the decades before Charles Darwin turned the public's attention toward biology. Today, it hard to imagine a lecture on geology attracting an audience outside of an academic setting, but in the early 19th century, people flocked to lectures on the latest fossil discoveries, descriptions of geological strata, and other obscure topics. Part of this was simply part of the Victorian mania for self-improvement, especially in the era before universal public education, but there is no doubt that geology also was the "hot" science of the period.

Several chapters of the book focus on geology as visual entertainment. Chapter 7, "Time Travel and Virtual Tourism in the Age of John Martin," describes the popularity of all sorts of visual spectacles as part of Victorian urban culture. The author describes in detail the work of John Martin, famous for his huge panoramic paintings of biblical scenes, such as "The Fall of Babylon," but also an early painter of dinosaurs and other extinct animals. Although much of the chapter deals with dioramas, both moving and fixed panoramas, and attractions such as the Eidophusikon, magic lanterns crop up from time to time in the discussion. The author mentions the proliferation of "-orama" attractions: panoramas, dioramas, astroramas, myrioramas, physioramas, stereoramas—the list goes on. He also mentions the integration of words derived from optical entertainments into everyday language: "The terms associated with these shows passed into common speech at the level of metaphor and simile. The phantasmagoria, for instance, provided a useful mental model for the perplexing visual sensations introduced by the high-speed railway, or the chaos of modern urban life" (p. 281). The chapter is illustrated with many interesting engravings and broadsides of panoramas and other visual shows, including a fascinating broadside for "The Gallery of Natural Magic" (1839) (p. 278), which including a succession of scenes which the author believes were dissolving views projected by a magic lantern.

In Chapter 9, the author compares geologist Gideon Mantell's description of geological history to a set of dissolving views: "...the mammoth, mastodon, and enormous deer and oxen now quietly browsed in the verdant plains—other changes succeeded—these colossal forms of life in their turn passed away" (p. 386). Chapter 10, "Hugh Miller and the Geologic Diorama," describes the writings of Scottish stonemason Hugh Miller, who became by far the most popular geological writer of the 19th century. Miller was a great fan of dioramas and panoramas and integrated language borrowed from these visual spectacles into his geological writings: "The geologic diorama abounds in strange contrasts. When the curtain last rose upon our country, we looked abroad over the amber-producing forests of the Tertiary period, with their sunlit glands and brown and bosky recesses, and we saw, far distant on the skirts of the densely wooded land, a fire-belching volcano, over-canopied by its cloud of smoke and ashes. And now, when the curtain again rises, we see the same tract occupied, far as the eye can reach, by a broad ocean, traversed by a pale milky line, that wends it dimpling way through the blue expanse, like a river through a meadow" (p. 405; from Miller's *Sketch-Book of Popular Geology*, 1859, p. 117).

For anyone interested in the role of 19th century visual spectacles, including magic lantern shows, in the culture of the period, and the intersection of literature, science, and entertainment, this is a wonderful book to read. The writing is engaging, the illustrations are fantastic, and the whole layout of the book is superbly done.—**The Editor**.

New Year's Greetings 1911

The Magic Lantern Society of the United States and Canada